United States Patent [19]

Rider

[11] **3,835,464**

[45] **Sept. 10, 1974**

[54] **POSITION INDICATOR FOR A DISPLAY SYSTEM**

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[73] Assignee: **Xerox Corporation,** Stamford, Conn.

[22] Filed: **Jan. 11, 1973**

[21] Appl. No.: **322,810**

[52] **U.S. Cl.** ..... **340/324 A,** 74/198

[51] **Int. Cl.** **G06f 3/14**

[58] **Field of Search** ..... 178/18–20; 340/324 A, 324 AD; 74/198

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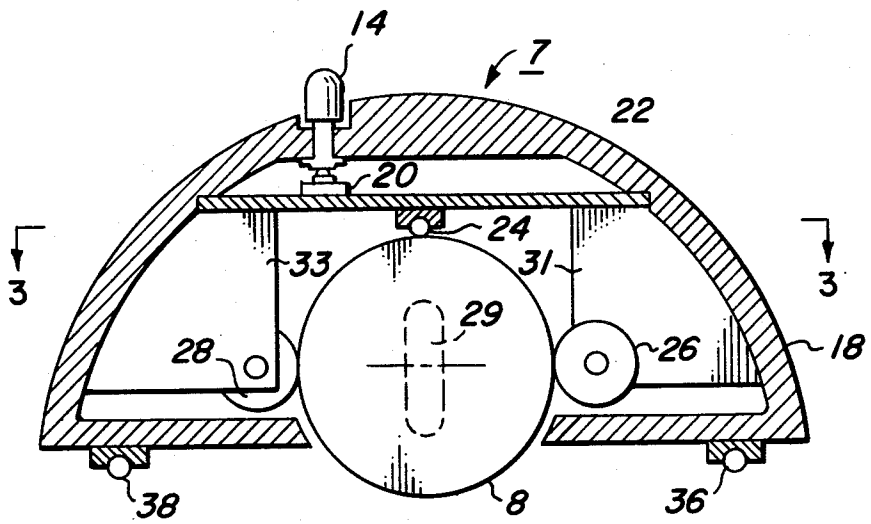
Primary Examiner—John W. Caldwell

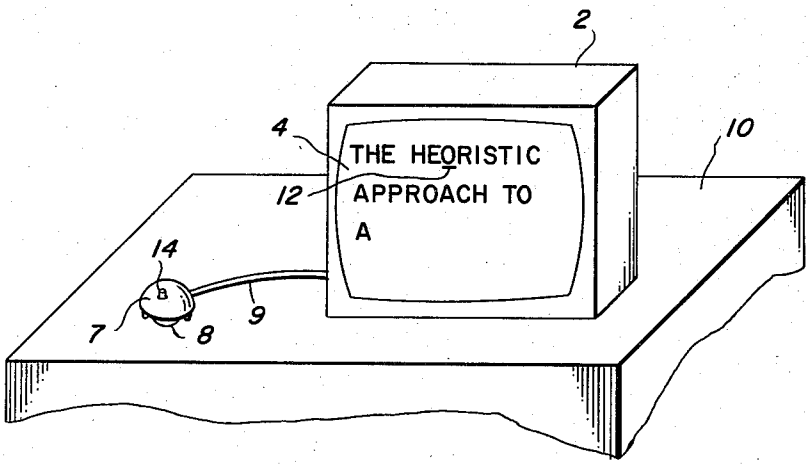
Assistant Examiner—Marshall M. Curtis

[57] **ABSTRACT**

The invention relates to a position indicator which rides over a surface for controlling a cursor over a visual display. The indicator generates signals indicative of its positions to cause the cursor to be displayed on the display at a corresponding position. The indicator includes a control mechanism that comprises a transport sphere in combination with position wheels indicative of Cartesian coordinates. The sphere is in contact with the surface over which the indicator rides and the position wheels contact the sphere at a position on the sphere approximately 90° from the contact loci of the sphere and the surface.

14 Claims, 4 Drawing Figures

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THE HEORISTIC
12
APPROACH TO
A
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FIG. 1

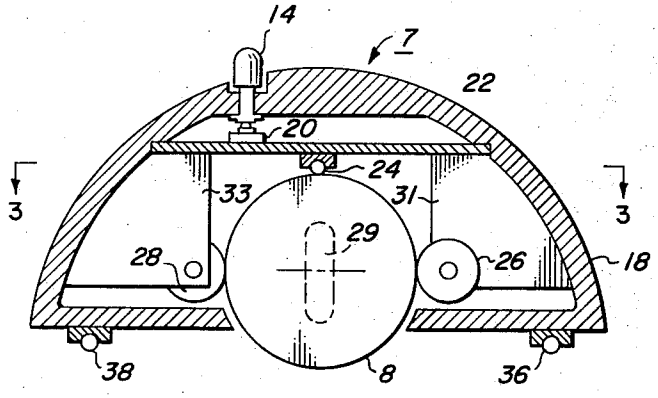
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FIG. 2

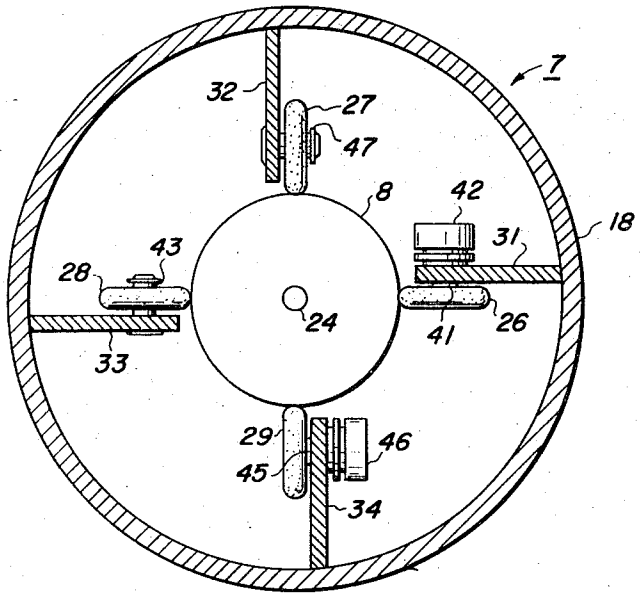
7
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FIG. 3

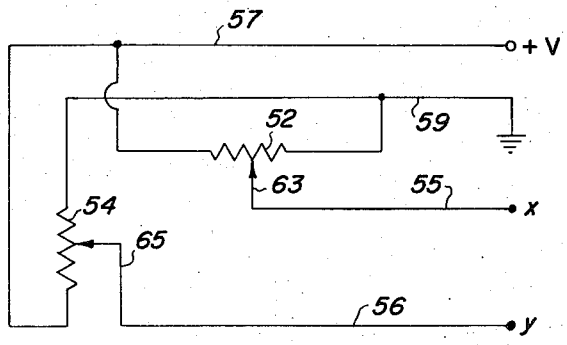
57
+V
52
59
63
55
x
54
65
56
y

FIG. 4

POSITION INDICATOR FOR A DISPLAY SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to display systems and, more particularly, to devices which alter the display at selected locations by controlling a cursor over the display.

U.S. Pat. No. 3,541,541 to Engelbart describes an X-Y position indicator control for movement by the hand over any surface to move a cursor over the display on a cathode ray tube. The indicator control mechanism of the Engelbart device contains X and Y position wheels mounted perpendicular to each other, which rotate according to the X and Y movements of the mechanism, and which operate rheostats to send signals along a wire to a computer which controls a CRT display.

The Engelbart device is a promising one for altering a display pattern on a cathode ray tube. The use of the cursor allows the operator to accurately indicate the exact position on the display on which he can make alterations. The X-Y position indicating device is a practicable mechanism for controlling the position of the cursor relative to the display pattern.

A disadvantage of the Engelbart device is that its movement over a surface is dependent upon the movement of the X-Y position wheels themselves. Hence, the device is biased to move in X and Y directions respective to the planes of the X and Y position wheels.

It is thus an object of the present invention to provide an X-Y position indicator for controlling a cursor over a visual display which is not biased in any given direction of movement.

It is a further object of the present invention to provide a position indicator for controlling a cursor over a visual display which includes a control mechanism that has as its transport means a sphere capable of rotation in any given direction.

It is yet another object of the present invention to provide a position indicator which may ride over any surface for controlling a cursor over a visual display.

It is still another object of the present invention to provide a position indicator for controlling a cursor over a visual display which has a control mechanism that comprises a transport sphere in combination with position wheels ensuring no preferred direction of movement.

Other objects of the present invention will be evident from the description hereinafter presented.

SUMMARY OF THE INVENTION

The invention provides a position indicator for controlling a cursor over a display on a cathode ray tube. The indicator generates signals indicative of its position to cause the cursor to be displayed on the CRT at a corresponding position.

Another feature of the invention is that the position indicator rides over a surface about a transport sphere. The movement of the transport sphere causes signals to be generated from the indicator indicative of its position.

Yet another feature of the present invention is that the control mechanism further includes position wheels in combination with the transports sphere such that the wheels contact this sphere at a position on the sphere

90° from the contact locii of the sphere and the supporting surface. The movement of the indicator over the surface is translated into the movement of the sphere in rotation about its radius. The radial rotation of the sphere is in turn translated into Cartesian coordinates respective to the resulting movement of the position wheels.

It is still another feature of the invention that the position wheels are coupled to a circuit which sends signals which control the display in accordance with the respective movements of the position wheels.

These and other features which are considered to be characteristic of this invention are set forth with particularity in the appended claims. The invention itself, however, as well as additional objects and advantages thereof, will best be understood from the following description when considered in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an illustration of a display system in accordance with the invention;

FIG. **2** is a sectional elevation view of the position indicator shown in FIG. **1**;

FIG. **3** is a sectional top view of the position indicator of FIG. **2** taken at line **3—3**; and

FIG. **4** is a schematic diagram of an electrical circuit for translating the relative movements of the indicator position wheels of FIGS. **2** and **3** into usable electrical signals for cursor control in accordance with the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **1** shows an illustrative display system in combination with a position indicator for cursor control. A cathode ray tube (CRT) display **2** is one of many commercial displays which may create visual patterns on the face **4** of a cathode ray tube. A computer system and a typewriter input apparatus (not shown) generates signals that define the patterns displayed by the CRT display system. A position indicator **7** is connected to the computer for transmitting signals which are to control the movement of the cursor upon the face **4** of the display **2.** The indicator **7** moves through the rotation of a transport sphere **8** across a supporting surface **10.** The position of the cursor **12** is thereby governed by the position of the indicator **7** determined by the computer in accordance with the signals received from the indicator **7** over the connecting wire **9.**

Three buttons **14** are located on the indicator **7** for operating switches within the indicator **7** to allow current to flow through the conductors of the wire **9.** The switches may be used to cause changes in particular areas of the display, or for other purposes. For example, one of the buttons may be used to control the delivering signals which command the computer to operate on portions of the pattern displayed immediately above the cursor **12,** such as a single character. The particular operation is designated by an input to the typewriter apparatus associated with the computer. Another button may be used to command the operations to be performed on the entire line of characters immediately above and to the right of the cursor **12.** An operation such as "erase" may be designated by pressing a particular key on the typewriter to cause the computer to stop the display of characters in those areas. These

characters can be inserted into the display by leaving the position indicator **7** stationary so the cursor does not move and then typing in the new characters on the typewriter. In FIG. **1**, for example, one may move the indicator **7** such that the cursor **12** is located beneath the letter o in the word "heuristic" in order to make the appropriate letter change.

In FIG. **2** is shown the internal mechanism of the indicator **7**. An outer housing **18** is shown to inclose more than half of the outer surface of the transports sphere **8**. A portion of the sphere **8** extends through an aperture in the bottom of the housing **18** to contact the supporting surface **10**. The aperture is sufficiently small to retain the sphere **8** within the housing **18**. The three push button switches **14** are slideably mounted in the housing **18** at its upper portion to contact respective push button switches **20** which close circuits that cause changes in the CRT display. The switches **20** are mounted on a plane **22** which is embedded in the housing **18**.

The transport sphere **18** is constrained within the indicator **7** by means of a bearing **24** mounted on the bottom surface of the plane **22** to restrict the movement of the sphere **8** in the upward direction. The sphere **8** is constrained horizontally by wheels **26-29**, which are rotatably mounted in respective housing flanges **31-34**. Bearings **36-39**, two of which are shown, are disposed on the bottom of the housing **18** to prevent any undesirable contact of the housing's periphery with the surface **10**. For a fully stable structure with the indicator **7** at rest on the surface **10**, at least two of the bearings could be provided in contact with the surface **10** in combination with the sphere **8** to give at least a tripodal support arrangement for the indicator.

Another support arrangement for the indicator **7** is to employ at least three of the bearings in contact with the surface **10** in at least a tripodal support arrangement. This arrangement has the advantage of not requiring the sphere **8** to be a support element. The sphere **8** may be freed from being a support element by removing the bearing **24** from the plane **22** and providing sufficient clearance between the sphere **8** and the plane **22** to avoid any contact between them. In this embodiment the sphere **8** remains in contact with the surface **10** solely through the force of gravity.

As shown in FIG. **3**, the wheels **26** and **29** are position wheels which represent Cartesian coordinates, for example, X and Y coordinate positions. The position wheels **26** and **29** are respectively connected to potentiometers **42** and **46** through shafts **41** and **45**. The shafts **41** and **45** are perpendicular to each other. Opposite the position wheel **26** is the wheel **28** which acts as both a support and an idler for the sphere **8**. The wheel **28** rotates on a shaft **43** which is substantially parallel to the shaft **41** of the position wheel **26**. Opposite from the position wheel **29** is the wheel **27** which acts both as a support and idler for the sphere **8**. The wheel **27** rotates about a shaft **47** which is substantially parallel to the shaft **45** of the position wheel **29**. In this preferred embodiment, the wheels **26-29** rotate in planes which are substantially orthogonal to the supporting surface **10** and contact the surface of the sphere **8** at a position on the sphere which is approximately 90° from the contact loci of the sphere **8** and the surface **10**.

The sphere **8** and the wheels **26-29** may be of any material which insures stable dimensions and relative motion between the position wheels **26** and **29** and the sphere **8** without slippage. A suitable construction of the sphere **8** is to provide a steel base with a thin coating of a material, such as rubber, having a high coefficient of friction. The wheels **26-29** may be similarly constructed. Of course, if the sphere **8** is not to be a support element for the indicator **8**, fewer stresses will be placed on it and thus an even wider variety of materials may be provided.

The movement of the indicator **7** over the surface **10** is translated into the movement of the sphere **8** in rotation about its radius. The radial rotation of the sphere **8** is in turn translated into two coordinates of radial movement respective to the resulting movement of the position wheels **26** and **29**. As the position wheels **26** and **29** rotate, the shafts of their respective potentiometers **42** and **46** rotate, thus varying their internal resistances. By a continuous measurement of the respective resistances of the potentiometers **42** and **46**, the extent of movement of the indicator **7** in relation to the coordinates defined by the position wheels **26** and **29** may be determined. Multi-turn potentiometers may be employed either to enable the monitoring of large movements of the indicator **7** or to enable fine control.

The position indicator **7** may be utilized by moving it to cause corresponding movements in the apparent position of the cursor **12** until the cursor lies in a desired location. As shown in FIG. **4**, the resistances **52** and **54** of the potentiometers **42** and **46**, respectively, are sensed through the conductors **55** and **56** which are contained in the wire **9** and continuously monitor the position of the indicator **7** and accordingly cause the desired movement of the cursor **12**.

FIG. **4** is a schematic diagram of an electrical circuit by which the position of the indicator **7** is monitored. Electrical conductors **55, 56, 57** and **59** represent separate leads contained in the wire **9** connecting the indicator **7** to the computer. A voltage + V is connected to the conductor **57** for sending currents through the two potentiometers **42** and **46** whose resistances are indicated as **52** and **54**, respectively. One side of each of the resistances **52** and **54** are connected by the conductor **59** to ground. The wipers **63** and **65** of the potentiometers **42** and **46**, respectively, are connected to the conductors **55** and **56** which in turn are connected to terminals X and Y. By measuring the voltage at X and Y, relative to the ground potential, the resistances **52** and **54** and therefore the X and Y positions of the indicator **7** are known. The indications of the X and Y position given by the voltages at the terminals X and Y are represented in analog form.

A digital computer, though, requires digital inputs and therefore an analog-to-digital converter must be used between the X and Y terminals and the computer inputs. Various types of digital output devices for use with the indicator **7** are described in U.S. Pat. No. 3,541,541.

Obviously, many modifications of the present invention are possible in light of the above teaching. It is therefore to be understood that, in the scope of the appended claims, the invention may be practiced other than as specifically described.

What is claimed is:

1. Position indicator apparatus for a display system controlled by a computer whereby the display is alterable in accordance with signals delivered to said computer which indicate positions on said display and

changes desired to be made therein, said apparatus being movable over a surface to provide position indications corresponding to positions on said display, comprising:

a housing,

means for supporting said housing on said surface and transporting said housing over said surface, said means comprising spherical means in contact with said surface,

said spherical means further comprising means for translating the movement of said housing into radial information, and

transducer means responsive to said spherical means for delivering signals to said computer for indicating the movement and position of said housing.

2. The position indicator apparatus of claim **1** wherein said transducer means includes referencing means for translating said radial information into Cartesian information which is represented by respective signals delivered to said computer.

3. The position indicator apparatus of claim **2** wherein said referencing means comprises at least two rotational means in contact with said spherical means which are coupled to respective potentiometer means for delivering said respective signals.

4. The position indicator apparatus of claim **3** wherein said spherical means is a sphere and said rotational means are wheels in contact with said sphere responsive only to the movement of said sphere, said sphere being in contact with a surface over which said indicator means is moved and thereby responsive to the movement of said indicator means.

5. The position indicator apparatus of claim **4** wherein two of said wheels contact said sphere at a position on said sphere approximately 90° from the contact loci of said sphere and the surface.

6. Position indicator apparatus for a display system controlled by a computer whereby the display is alterable in accordance with signals delivered to said computer which indicate positions on said display and changes desired to be made therein, said apparatus being movable over a surface to provide position indications corresponding to positions on said display, comprising:

a housing,

means for supporting said housing on said surface and transporting said housing over said surface,

said supporting means including spherical means constrained within said housing in contact with said surface for translating the movement of said housing into radial information, and

transducer means responsive to said spherical means for delivering signals to said computer for indicating the movement and position of said housing.

7. The position indicator apparatus of claim **6** wherein said transducer means includes referencing means for translating said radial information into Cartesian information which is represented by respective signals delivered to said computer.

8. The position indicator apparatus of claim **7** wherein said referencing means comprises at least two rotational means in contact with said spherical means which are coupled to respective potentiometer means for delivering said respective signals.

9. The position indicator apparatus of claim **8** wherein said spherical means is a sphere and said rotational means are wheels in contact with said sphere responsive only to the movement of said sphere, said sphere being in contact with a surface over which said indicator means is moved and thereby responsive to the movement of said indicator means.

10. The position indicator apparatus of claim **9** wherein two of said wheels contact said sphere at a position on said sphere approximately 90° from the contact loci of said sphere and the surface.

11. The position indicator apparatus of claim **10** wherein the axes of said wheels are substantially perpendicular to each other.

12. The position indicator apparatus of claim **1** wherein said spherical supporting means is constrained in the vertical coordinate within said housing in a direction away from said surface at a point of tangency with its outer surface.

13. The position indicator apparatus of claim **12** wherein said supporting means further comprises at least two supporting elements attached to said housing, which elements in combination with said spherical supporting means comprises at least a tripodal supporting means for said indicator.

14. The position indicator apparatus of claim **13** wherein said spherical supporting means is unconstrained in the opposite direction of said vertical coordinate within said housing such that said spherical means remains in contact with said surface even if said surface has irregularities.

* * * * *

REEXAMINATION CERTIFICATE (273rd)

United States Patent [19]

Rider

[11] **B1 3,835,464**

[45] Certificate Issued **Nov. 20, 1984**

[54] **POSITION INDICATOR FOR A DISPLAY SYSTEM**

[75] Inventor: **Ronald E. Rider**, Menlo Park, Calif.

[73] Assignee: **Xerox Corporation**, Stamford, Conn.

Reexamination Request:
No. 90/000,415, Jul. 5, 1983

Reexamination Certificate for:

Patent No.:	**3,835,464**
Issued:	**Sep. 10, 1974**
Appl. No.:	**322,810**
Filed:	**Jan. 11, 1973**

[51] **Int. Cl.**[3] **G06F 3/14**

[52] **U.S. Cl.** ..... **340/710**; 178/18; 74/198; 74/471 XY

[58] **Field of Search** ..... 340/710, 709, 347 AD, 340/347 DA, 347 P; 33/125 M, 125 C, 125 A, 125 R, 141 R, 141 B, 141 E, 141 F, 141.5, 142; 74/198, 471 R, 471 XY; 318/560, 565, 580, 575, 663, 665, 670, 2; 178/18-20

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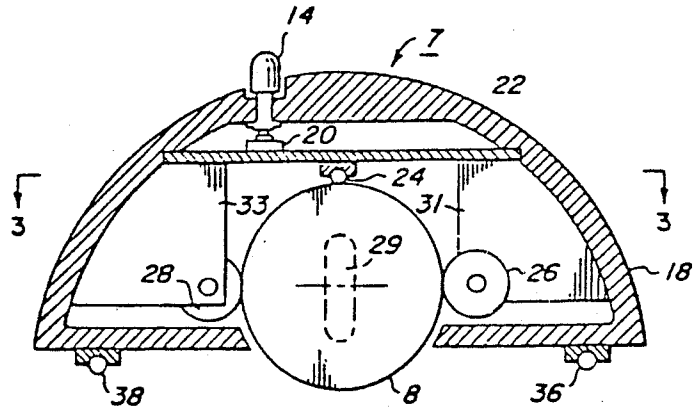
Primary Examiner—Marshall M. Curtis

[57] **ABSTRACT**

The invention relates to a position indicator which rides over a surface for controlling a cursor over a visual display. The indicator generates signals indicative of its positions to cause the cursor to be displayed on the display at a corresponding position. The indicator includes a control mechanism that comprises a transport sphere in combination with position wheels indicative of Cartesian coordinates. The sphere is in contact with the surface over which the indicator rides and the position wheels contact the sphere at a position on the sphere approximately 90° from the contact loci of the sphere and the surface.



REEXAMINATION CERTIFICATE ISSUED UNDER 35 U.S.C. 307.

THE PATENT IS HEREBY AMENDED AS INDICATED BELOW.

Matter enclosed in heavy brackets [ ] appeared in the patent, but has been deleted and is no longer a part of the patent; matter printed in italics indicates additions made to the patent.

ONLY THOSE PARAGRAPHS OF THE SPECIFICATION AFFECTED BY AMENDMENT ARE PRINTED HEREIN.

Column 3 lines 21–34:

The transport sphere **[18]** *8* is constrained within the indicator **7** by means of a bearing **24** mounted on the bottom surface of the plane **22** to restrict the movement of the sphere **8** in the upward direction. The sphere **8** is constrained horizontally by wheels **26–29**, which are rotatably mounted in respective housing flanges **31–34**. Bearings **36–39**, two of which are shown, are disposed on the bottom of the housing **18** to prevent any undesirable contact of the housing's periphery with the surface **10**. For a fully stable structure with the indicator **7** at rest on the surface **10**, at least two of the bearings could be provided in contact with the surface **10** in combination with the sphere **8** to give at least a tripodal support arrangement for the indicator.

AS A RESULT OF REEXAMINATION, IT HAS BEEN DETERMINED THAT:

Claims **1–13** are cancelled.

Claim **14** is determined to be patentable as amended.

New claims **15–17** are added and determined to be patentable.

14. *Position indicator apparatus for a display system controlled by a computer whereby the display is alterable in accordance with signals delivered to said computer which indicate positions on said display and changes desired to be made therein, said apparatus being movable over a surface to provide position indications corresponding to positions on said display, comprising:*

a housing,

means for supporting said housing on said surface and transporting said housing over said surface, said means comprising spherical means in contact with said surface,

said spherical means further comprising means for translating the movement of said housing into radial information, and

transducer means responsive to said spherical means for delivering signals to said computer for indicating the movement and position of said housing,

said spherical supporting means is constrained in the vertical coordinate within said housing in a direction away from said surface at a point of tangency with its outer surface,

said supporting means further comprises at least two supporting elements attached to said housing, which elements in combination with said spherical supporting means comprises at least a tripodal supporting means for said indicator, **[**The position indicator apparatus of claim **13** wherein**]**

said spherical supporting means **[**is**]** *being* unconstrained in the opposite direction of said vertical coordinate within said housing such that said spherical means remains in contact with said surface even if said surface has irregularities.

15. Position apparatus for a display system controlled by a computer whereby the display is alterable in accordance with signals delivered to said computer which indicate positions on said display and changes desired to be made therein, said apparatus being movable over a surface to provide position indications corresponding to positions on said display, said apparatus comprising:

a housing,

spherical means for supporting said housing on said surface to transport said housing over said surface in contact therewith,

means associated with the surface of said spherical means for translating the movement of said housing into radial information,

transducer means responsive to said spherical means for delivering signals to said computer for indicating the movement and position of said housing,

at least two supporting elements attached to said housing, said elements in combination with said spherical means constituting at least a tripodal supporting means for said position indicator apparatus,

said spherical means being freely movable in said housing in a direction transverse relative to a plane which is parallel to said surface and which passes through said supporting elements,

said spherical means being freely movable in said direction so the lowermost portion thereof can remain in contact with said surface due to gravity.

16. The position indicator apparatus of claim 15 wherein said spherical means also being freely movable in said transverse direction within limits still permitting engagement of said transducer means with the surface of said spherical means.

17. The position indicator apparatus of claim 16 wherein there is means in said housing in said transverse direction above said spherical means to prevent said spherical means from completely receding into the confines of said housing above said plane.

* * * * *